a rule processing engine comprising

a processor executing a health state assessment algorithm that performs a medical evaluation and determines a confidence level for the evaluation, said algorithm comprising a rule set to calculate a health state classification and indicator of confidence.

2. The life signs detection system of claim 1 wherein the processing engine employs a subject personal baseline dependent rule set and tabulated parameter values.

3. The life signs detection system of claim 1 wherein the transmitter of the wearable platform is a short range RF transmitter having low bandwidth output for local sensor data.

4. The life signs detection system of claim 1 wherein the local transceiver hub comprises a short range RF transceiver, a medium or long range transmitter/transceiver and a processor.

5. The life signs detection system of claim 1 wherein said local sensor data comprises periodic and on demand digital data packets of medical state information from said wearable platforms.

6. The life signs detection system of claim 1 wherein said remote base station is a PDA.

7. The life signs detection system of claim 1 wherein said algorithm estimates the likelihood of injury,

8. The life signs detection system of claim 1 wherein said algorithm estimates the likelihood of an injury and the nature of the injury

9. The life signs detection system of claim 1 wherein the processing engine employs a subject personal baseline dependent rule set.

10. The life signs detection system of claim 1 wherein said display comprises color coded health state classifications and decision confidence score.

11 A life signs detection system for monitoring subjects, said system comprising

a plurality of wearable platforms, each wearable platform comprising

a sensor subsystem having a respiration rate sensor that detects abdominal motion of a subject,

a processor, and

a transmitter for local sensor data of medical state information ,

a plurality of local hubs each comprising

a separate wearable package comprising

a local transceiver hub accepting connection from an external display and comprising

a receiver for local sensor data from said wearable platforms,

a remote base station receiving information from a plurality of local hubs and comprising said external display, and

a rule processing engine comprising

a processor executing a health state assessment algorithm that performs a medical evaluation and determines a confidence level for the evaluation, said algorithm comprising a rule set to calculate a health state classification and indicator of confidence,

said rule set providing data prioritization determining the order for proceeding through data interpretation rules for which value levels are predetermined,

said algorithm comprising interpretation rules for each health state.

12. The life signs detection system of claim 11 wherein the processing engine employs a subject personal baseline dependent rule set and tabulated parameter values.

13. The life signs detection system of claim 11 wherein said algorithm comprises tabulated interpretation rules and tabulated boundary conditions and tabulated abnormal values for each personal baseline.

14. The life signs detection system of claim 11 wherein the transmitter of the wearable platform is a short range RF transmitter having low bandwidth output for local sensor data.

15. The life signs detection system of claim 11 wherein the local transceiver hub comprises a short range RF transceiver, a medium or long range transmitter/transceiver and a processor.

16. The life signs detection system of claim 11 wherein said local sensor data comprises periodic and on demand digital data packets of medical state information from said wearable platforms.

17. The life signs detection system of claim 11 wherein said remote base station is a PDA.

18. The life signs detection system of claim 11 wherein said algorithm estimates the likelihood of injury,

19. The life signs detection system of claim 11 wherein said algorithm estimates the likelihood of an injury and the nature of the injury

20. The life signs detection system of claim 11 wherein the processing engine employs a subject personal baseline dependent rule set.

21. The life signs detection system of claim 11 wherein said display comprises color coded health state classifications and decision confidence score.

22. A life signs detection system for monitoring subjects, said system comprising

a plurality of wearable platforms, each wearable platform comprising

a sensor subsystem having a respiration rate sensor that detects abdominal motion of a subject,

a processor, and

a transmitter for local sensor data of medical state information ,

a plurality of local hubs each comprising

a separate wearable package comprising

a local transceiver hub accepting connection from an external display and comprising

a receiver for local sensor data from said wearable platforms,

a remote base station receiving information from a plurality of local hubs and comprising said external display, and

a rule processing engine comprising

a processor executing a health state assessment algorithm that performs a medical evaluation and determines a confidence level for the evaluation, said algorithm comprising a rule set to calculate a health state classification and indicator of confidence,

said rule set providing data prioritization determining the order for proceeding through data interpretation rules for which value levels are predetermined,

said algorithm comprising interpretation rules for each health state.

wherein the confidence level is based on the likelihood of new state transitions and utilizes decision matrices dependent upon the number of parameter values received in a predetermined time interval.

23. The life signs detection system of claim 22 wherein the processing engine employs a subject personal baseline dependent rule set and tabulated parameter values.

24. The life signs detection system of claim 22 wherein said algorithm comprises tabulated interpretation rules and tabulated boundary conditions and tabulated abnormal values for each personal baseline.

25. The life signs detection system of claim 22 wherein the transmitter of the wearable platform is a short range RF transmitter having low bandwidth output for local sensor data.

26. The life signs detection system of claim 22 wherein the local transceiver hub comprises a short range RF transceiver, a medium or long range transmitter/transceiver and a processor.

27. The life signs detection system of claim 22 wherein said local sensor data comprises periodic and on demand digital data packets of medical state information from said wearable platforms.

28. The life signs detection system of claim 22 wherein said remote base station is a PDA

29. The life signs detection system of claim 22 wherein said algorithm estimates the likelihood of injury,

30. The life signs detection system of claim 22 wherein said algorithm estimates the likelihood of an injury and the nature of the injury

31. The life signs detection system of claim 22 wherein the processing engine employs a subject personal baseline dependent rule set.

32. The life signs detection system of claim 22 wherein said display comprises color coded health state classifications and decision confidence score.

33. A life signs detection system for monitoring subjects, said system comprising

a plurality of wearable platforms, each wearable platform comprising

a sensor subsystem having a respiration rate sensor that detects abdominal motion of a subject,

a processor, and

a transmitter for local sensor data of medical state information ,

a plurality of local hubs each comprising

a separate wearable package comprising

a local transceiver hub accepting connection from an external display and comprising

a receiver for local sensor data from said wearable platforms,

a remote base station receiving information from a plurality of local hubs and comprising said external display, and

a rule processing engine comprising

a processor executing a health state assessment algorithm that performs a medical evaluation and determines a confidence level for the evaluation, said algorithm comprising a rule set to calculate a health state classification and indicator of confidence,

said rule set providing data prioritization determining the order for proceeding through data interpretation rules for which value levels are predetermined,

said algorithm comprising interpretation rules for each health state.

wherein the confidence level is based on the likelihood of new state transitions and utilizes decision matrices dependent upon the number of parameter values received in a predetermined time interval, said confidence score dependent upon

a parameter set

a state change score and

a data persistence score.

34. The life signs detection system of claim 33 wherein the processing engine employs a subject personal baseline dependent rule set and tabulated parameter values.

35. The life signs detection system of claim 33 wherein said algorithm comprises tabulated interpretation rules and tabulated boundary conditions and tabulated abnormal values for each personal baseline.

36. The life signs detection system of claim 33 wherein the transmitter of the wearable platform is a short range RF transmitter having low bandwidth output for local sensor data.

37. The life signs detection system of claim 33 wherein the local transceiver hub comprises a short range RF transceiver, a medium or long range transmitter/transceiver and a processor.

38. The life signs detection system of claim 33 wherein said local sensor data comprises periodic and on demand digital data packets of medical state information from said wearable platforms.

39. The life signs detection system of claim 33 wherein said remote base station is a PDA

40. The life signs detection system of claim 33 wherein said algorithm estimates the likelihood of injury,

41. The life signs detection system of claim 33 wherein said algorithm estimates the likelihood of an injury and the nature of the injury

42. The life signs detection system of claim 33 wherein the processing engine employs a subject personal baseline dependent rule set.

43. The life signs detection system of claim 33 wherein said display comprises color coded health state classifications and decision confidence score.

44. A life signs detection system for monitoring one significant vital sign and one indirect life sign of subjects, said system comprising

a plurality of wearable platforms, each wearable platform comprising

a sensor subsystem comprising

a heart rate sensor,

a body motion sensor

a respiration rate sensor, and

a temperature sensor,

wherein the respiration rate sensor detects motion of a subject,

a processor, and

a transmitter for local sensor data of medical state information ,

a plurality of local hubs each comprising

a separate wearable package comprising

a local transceiver hub accepting connection from an external display and comprising

a receiver for local sensor data from said wearable platforms,

a remote base station receiving information from a plurality of local hubs and comprising said external display, and

a rule processing engine comprising

a processor executing a health state assessment algorithm that performs a medical evaluation and determines a confidence level for the evaluation, said algorithm comprising a rule set to calculate a health state classification and indicator of confidence.

45. The life signs detection system of claim 44 wherein the processing engine employs a subject personal baseline dependent rule set and tabulated parameter values.

46. The life signs detection system of claim 44 wherein the respiration rate sensor detects abdominal motion of the subject.

47. The life signs detection system of claim 44 wherein said algorithm comprises tabulated interpretation rules and tabulated boundary conditions and tabulated abnormal values for each personal baseline.

48. The life signs detection system of claim 44 wherein the transmitter of the wearable platform is a short range RF transmitter having low bandwidth output for local sensor data.

49. The life signs detection system of claim 44 wherein the local transceiver hub comprises a short range RF transceiver, a medium or long range transmitter/transceiver and a processor.

50. The life signs detection system of claim 44 wherein said local sensor data comprises periodic and on demand digital data packets of medical state information from said wearable platforms.

51. The life signs detection system of claim 44 wherein said remote base station is a PDA

52. The life signs detection system of claim 44 wherein said algorithm estimates the likelihood of injury,

53. The life signs detection system of claim 44 wherein said algorithm estimates the likelihood of an injury and the nature of the injury

54. The life signs detection system of claim 44 wherein the processing engine employs a subject personal baseline dependent rule set.

55. The life signs detection system of claim 44 wherein said display comprises color coded health state classifications and decision confidence score.

56. A life signs detection system for monitoring one significant vital sign and one indirect life sign of subjects , said system comprising

a plurality of wearable platforms, each wearable platform comprising

a sensor subsystem comprising

a heart rate sensor,

a body motion sensor

a respiration rate sensor, and

a temperature sensor,

wherein the respiration rate sensor detects motion of a subject,

a processor, and

a transmitter for local sensor data of medical state information ,

a plurality of local hubs each comprising

a separate wearable package comprising

a local transceiver hub accepting connection from an external display and comprising

a receiver for local sensor data from said wearable platforms,

a remote base station receiving information from a plurality of local hubs and comprising said external display, and

a rule processing engine comprising

a processor executing a health state assessment algorithm that performs a medical evaluation and determines a confidence level for the evaluation, said algorithm comprising a rule set to calculate a health state classification and indicator of confidence,

said rule set providing data prioritization determining the order for proceeding through data interpretation rules for which value levels are predetermined,

said algorithm comprising interpretation rules for each health state.

57. The life signs detection system of claim 56 wherein the processing engine employs a subject personal baseline dependent rule set and tabulated parameter values.

58. The life signs detection system of claim 56 wherein the respiration rate sensor detects abdominal motion of the subject.

59. The life signs detection system of claim 56 wherein said algorithm comprises tabulated interpretation rules and tabulated boundary conditions and tabulated abnormal values for each personal baseline.

60. The life signs detection system of claim 56 wherein the transmitter of the wearable platform is a short range RF transmitter having low bandwidth output for local sensor data.

61. The life signs detection system of claim 56 wherein the local transceiver hub comprises a short range RF transceiver, a medium or long range transmitter/transceiver and a processor.

62. The life signs detection system of claim 56 wherein said local sensor data comprises periodic and on demand digital data packets of medical state information from said wearable platforms.

63. The life signs detection system of claim 56 wherein said remote base station is a PDA

64. The life signs detection system of claim 56 wherein said algorithm estimates the likelihood of injury,

65. The life signs detection system of claim 56 wherein said algorithm estimates the likelihood of an injury and the nature of the injury

66. The life signs detection system of claim 56 wherein the processing engine employs a subject personal baseline dependent rule set.

67. The life signs detection system of claim 56 wherein said display comprises color coded health state classifications and decision confidence score.

68. A life signs detection system for monitoring one significant vital sign and one indirect life sign of subjects, said system comprising

a plurality of wearable platforms, each wearable platform comprising

a sensor subsystem comprising

a heart rate sensor,

a body motion sensor

a respiration rate sensor, and

a temperature sensor,

wherein the respiration rate sensor detects motion of a subject,

a processor, and

a transmitter for local sensor data of medical state information ,

a plurality of local hubs each comprising

a separate wearable package comprising

a local transceiver hub accepting connection from an external display and comprising

a receiver for local sensor data from said wearable platforms,

a remote base station receiving information from a plurality of local hubs and comprising said external display, and

a rule processing engine comprising

a processor executing a health state assessment algorithm that performs a medical evaluation and determines a confidence level for the evaluation, said algorithm comprising a rule set to calculate a health state classification and indicator of confidence,

said rule set providing data prioritization determining the order for proceeding through data interpretation rules for which value levels are predetermined,

said algorithm comprising interpretation rules for each health state, and

wherein the confidence level is based on the likelihood of new state transitions and utilizes decision matrices dependent upon the number of parameter values received in a predetermined time interval.

69. The life signs detection system of claim 68 wherein the processing engine employs a subject personal baseline dependent rule set and tabulated parameter values.

70. The life signs detection system of claim 68 wherein the respiration rate sensor detects abdominal motion of the subject.

71. The life signs detection system of claim 68 wherein said algorithm comprises tabulated interpretation rules and tabulated boundary conditions and tabulated abnormal values for each personal baseline.

72. The life signs detection system of claim 68 wherein the transmitter of the wearable platform is a short range RF transmitter having low bandwidth output for local sensor data.

73. The life signs detection system of claim 68 wherein the local transceiver hub comprises a short range RF transceiver, a medium or long range transmitter/transceiver and a processor.

74. The life signs detection system of claim 68 wherein said local sensor data comprises periodic and on demand digital data packets of medical state information from said wearable platforms.

75. The life signs detection system of claim 68 wherein said remote base station is a PDA

76. The life signs detection system of claim 68 wherein said algorithm estimates the likelihood of injury,

77. The life signs detection system of claim 68 wherein said algorithm estimates the likelihood of an injury and the nature of the injury

78. The life signs detection system of claim 68 wherein the processing engine employs a subject personal baseline dependent rule set.

79. The life signs detection system of claim 68 wherein said display comprises color coded health state classifications and decision confidence score.

80. A life signs detection system for monitoring one significant vital sign and one indirect life sign of subjects, said system comprising

a plurality of wearable platforms, each wearable platform comprising

a sensor subsystem comprising

a heart rate sensor,

a body motion sensor

a respiration rate sensor, and

a temperature sensor,

wherein the respiration rate sensor detects motion of a subject,

a processor, and

a transmitter for local sensor data of medical state information ,

a plurality of local hubs each comprising

a separate wearable package comprising

a local transceiver hub accepting connection from an external display and comprising

a receiver for local sensor data from said wearable platforms,

a remote base station receiving information from a plurality of local hubs and comprising

said external display, and

a rule processing engine comprising

a processor executing a health state assessment algorithm that performs a medical evaluation and determines a confidence level for the evaluation, said algorithm comprising a rule set to calculate a health state classification and indicator of confidence,

said rule set providing data prioritization determining the order for proceeding through data interpretation rules for which value levels are predetermined,

said algorithm comprising interpretation rules for each health state.

wherein the confidence level is based on the likelihood of new state transitions and utilizes decision matrices dependent upon the number of parameter values received in a predetermined time interval, said confidence score dependent upon

a parameter set

a state change score and

a data persistence score.

81. The life signs detection system of claim 80 wherein the processing engine employs a subject personal baseline dependent rule set and tabulated parameter values.

82. The life signs detection system of claim 80 wherein the respiration rate sensor detects abdominal motion of the subject.

83. The life signs detection system of claim 80 wherein said algorithm comprises tabulated interpretation rules and tabulated boundary conditions and tabulated abnormal values for each personal baseline.

84. The life signs detection system of claim 80 wherein the transmitter of the wearable platform is a short range RF transmitter having low bandwidth output for local sensor data.

85. The life signs detection system of claim 80 wherein the local transceiver hub comprises a short range RF transceiver, a medium or long range transmitter/transceiver and a processor.

86. The life signs detection system of claim 80 wherein said local sensor data comprises periodic and on demand digital data packets of medical state information from said wearable platforms.

87. The life signs detection system of claim 80 wherein said remote base station is a PDA

88. The life signs detection system of claim 80 wherein said algorithm estimates the likelihood of injury,

89. The life signs detection system of claim 80 wherein said algorithm estimates the likelihood of an injury and the nature of the injury

90. The life signs detection system of claim 80 wherein the processing engine employs a subject personal baseline dependent rule set.

91. The life signs detection system of claim 80 wherein said display comprises color coded health state classifications and decision confidence score.

92. A life signs detection system (LSDS) for monitoring one significant vital sign and one indirect life sign of a subject, said system comprising

a plurality of wearable platforms, each wearable platform comprising

a sensor subsystem comprising

a heart rate sensor,

a body motion sensor

a respiration rate sensor, and

a temperature sensor,

wherein the respiration rate sensor detects abdominal motion and is capable of detecting motion of the subject,

a processor

a short range RF transmitter having low bandwidth output for local sensor data,

a plurality of local hubs each comprising

a separate wearable package comprising

a local transceiver hub comprising

a short range RF transceiver

a medium or long range transmitter/transceiver, and

a processor

said separate wearable package accepting connection from one or more external displays and comprising

a receiver for local sensor data comprising

periodic and on demand digital data packets of medical state information from said wearable platforms and,

a remote base station receiving information from a plurality of local hubs and comprising an external display,

wherein the remote base station is a PDA, and

a rule processing engine comprising

a processor executing a health state assessment algorithm, wherein said algorithm estimates the likelihood of injury and the nature of an injury, performs a medical evaluation and determines a confidence level for each of multiple measurements, said algorithm comprising

a processing engine employing a subject personal baseline dependent

rule set and

tabulated parameter values

to calculate and display color-coded health state classification and indicators of confidence, determining physiologic state, decision confidence score and triage indications,

said rule set providing data prioritization determining the order for proceeding through data interpretation rules for which value levels are predetermined,

said algorithm comprising tabulated interpretation rules for each health state and applying tabulated boundary conditions and tabulated abnormal values for each personal baseline,

wherein the confidence level is based on the likelihood of new state transitions and utilizes decision matrices dependent upon the number of parameter values received in a predetermined time interval, said confidence level dependent upon

a parameter set

a state change score and

a data persistence score.

93. A system for processing information on the physical status of one or more subjects comprising

apparatus for transmitting information comprising

a carrier for sensors arranged to be worn by the subjects for providing electrical signals including amplitude and duration values representative of physical parameters of the subjects, and

a host receiver having a processor that determines whether the amplitude and duration values fall within acceptable limits.

94. The system for processing information on the physical status of one or more subjects of claim 93, having a communications protocol that assigns a set of sensors to a single hub, and a set of hubs to a single remote station.

95. The system for processing information on the physical status of one or more subjects of claim 94, wherein a local protocol provides the transport of data between one or more sensors and a single hub.

96. The system for processing information on the physical status of one or more subjects of claim 95, said system comprising a plurality of sensors, and wherein a local data packet format is extensible, not requiring changes to the hub to accommodate new sensor additions.

97. The system for processing information on the physical status of one or more subjects of claim 96, wherein gaps in the sensor data are accounted for by providing a filler packet, or by the indication that the sensor is no longer communicating.

98. The system for processing information on the physical status of one or more subjects of claim 96, wherein the filler packet comprises a timestamp.

99. The system for processing information on the physical status of one or more subjects of claim 98, wherein a distant protocol provides the transport of data between a hub, and the remote station.

100. The system for processing information on the physical status of one or more subjects of claim 99, wherein the distant protocol allows for interruptions in the data stream, with later recovery of data stored within the hub.

101. The system for processing information on the physical status of one or more subjects of claim 100, wherein the host receiver is comprised within a hub system that has a user interface that provides a local health display, wherein the host receiver further comprises a local selection mechanism to facilitate the initial association of one or more sensors to a specific hub.

102. The system for processing information on the physical status of one or more subjects of claim 93, wherein the association of a specific hub to a remote station is performed at the hub, or via a remote communications link, either to a medic PDA, or back to a remote station.

103. The system for processing information on the physical status of one or more subjects of claim 102, wherein the remote subsystem has a user interface that displays the basic status of multiple hubs within a single display.

104. The system for processing information on the physical status of one or more subjects of claim 103, further comprising a display of status and data details from at least a single hub.

105. The system for processing information on the physical status of one or more subjects of claim 103, further comprising a medic PDA subsystem that has a user interface for displaying a

list of hubs to connect to, and a mechanism to connect and display the detailed data as delivered by the hub.

106. The system for processing information on the physical status of one or more subjects of claim 93, wherein a running average of the amplitude and duration values of a group of previous respiration cycles is transmitted to the host processor, wherein a small hysteresis value is applied to the respiration signal to minimize false "end of cycle" readings due to noise in the signal, and wherein said hysteresis value is dynamically adjusted based on the amplitude of the previous cycle.

107. A heart rate trend tracking algorithm, comprising running in parallel

a first process that tracks an already established trend,

a second process that looks for a new trend, and

a third process that determines which of the first and second processes has better data.

108. The heart rate trend tracking algorithm of claim 107, wherein before presenting incoming EKG data to the first process, it is filtered and noise corrected.

109. A heart rate trend tracking algorithm comprising

filtering and canceling noise from incoming EKG data

presenting the data to trend tracking routines comprising

a first process that tracks an already established trend,

a second process that looks for a new trend, and

a third process that determines which of the first and second processes has better data,

several times a second making a decision to keep using an existing trend or to shift to using a new trend

averaging and filtering the EKG data, and

converting the data into a beats-per-second value.

110. The heart rate calculation algorithm of claim 109, wherein each incoming EKG pulse is time stamped, and those remaining after filtering and noise cancellation are processed in non-real-time.

111. A method for transmitting information on the physical status of a subject comprising

running an algorithm comprising the steps of

looking for a new trend by

looking at four most recent inter-beat intervals and

developing a scoring based on the consistency of these intervals.

112. The method for transmitting information on the physical status of a subject of claim 111, further comprising using a window size of +/- 12.5%

113. The method for transmitting information on the physical status of a subject of claim 111, wherein only consistent inter-beat intervals are saved in a history array.

114. The method for transmitting information on the physical status of a subject of claim 111, wherein an existing trend is tracked by

assuming the heart rate to be at a certain frequency, and

looking for more heartbeats at these expected intervals,

ignoring extra pulses are ignored

inserting missing pulses.

115. The method for transmitting information on the physical status of a subject of claim 111, wherein an existing trend process is locked onto a new trend when that new trend is seen to be strong and stable comprising

maintaining a score for how well the trend is being tracked.

unlocking the existing trend when its score is low, and then

locking onto a new trend when the new trend is seen to exist.

116. The method for transmitting information on the physical status of a subject of claim 115, wherein an array of inter-beat intervals is maintained in order to provide the averaging process the information it needs.

117. The method for transmitting information on the physical status of a subject of claim 115, wherein if both the trend the trend tracking and acquisition processes have low scores, the heart rate status is set to "unstable".

118. The method for transmitting information on the physical status of a subject of claim 115, wherein if there are no heartbeats but the EKG contacts are determined to be on-body, then the heart rate status is set to indicate "none".

119. The method for transmitting information on the physical status of a subject of claim 115, wherein an averaging filter looks back in time through an array of historic inter-beat intervals until it sees at least 4 seconds of pulse timing, and then averages this most recent pulse timing.

120. The method for transmitting information on the physical status of a subject of claim 115, wherein a low pass filter stage limits how fast the heart rate can change, wherein, the rate at which the reported heart rate is allowed to approach the calculated heart rate based on the old and new trends is limited to 4 BPM per second.

121. An apparatus for transmitting information on the physical status of a subject comprising

a carrier for sensors arranged to be worn by the subject for providing electrical signals representative of physical parameters of the subject, said carrier comprising

a central housing,

two flexible extensions containing external sensors, and

a harness, and

electronics residing on a PC board to receive and interpret the electrical signals from the sensors, and to process the signals at the location of the subject and send it wirelessly to a local receiver or transceiver for retransmission to a separate computer station,

said electronics measures life signs comprising

heart rate by detecting and timing EKG R-waves,

physical activity and orientation from signals provided by an accelerometer,

respiration rate by reading a chest expansion sensor, and

temperature.

122. The apparatus for transmitting information on the physical status of a subject of claim 121, further comprising electronics to analyzing the life signs using a health state determination algorithm and transmitting the resulting health indication, plus the raw data behind it out of the sensor.

123. The apparatus for transmitting information on the physical status of a subject of claim 122, wherein the transmission is to a local receiver approximately every two seconds.

124. An electronics package for an apparatus for transmitting information on the physical status of a subject, comprising

a microprocessor having

low power draw,

program memory,

RAM memory,

EEPROM for non-volatile storage,

general purpose I/O,

analog inputs,

external interrupts,

timers,

high and low speed clocks,

low-power sleep modes,

in-circuit programmability, and

development tools.

125. The electronics package for an apparatus for transmitting information on the physical status of a subject of claim 124, wherein the microprocessor employs sleep modes, wherein a high speed crystal runs the processor when it is awake, and a lower-frequency crystal keeps the internal timers running when both awake and in a low-power standby mode.

126. The electronics package for an apparatus for transmitting information on the physical status of a subject of claim 124, wherein the apparatus comprises sensors and the output of the sensors is transmitted to a local receiver for further transmission to a more remote station, said sensors comprising a flex sensor with a variable resistance, that is changed by the electronics into a voltage that is frequency limited using a band pass filter and sampled by the processor using one of its built-in analog-to-digital inputs.

127. The electronics package for an apparatus for transmitting information on the physical status of a subject of claim 126, further comprising an RF transmitter, wherein a 1 kHz Manchester-encoded data stream is sent out the RF transmitter once every two seconds.

128. The electronics package for an apparatus for transmitting information on the physical status of a subject of claim 127, wherein the transmitter uses simple on-off keying, thus only drawing power when transmitting a "1".

129. The electronics package for an apparatus for transmitting information on the physical status of a subject of claim 127, wherein activity is measured periodically in order to determine how much movement the user is experiencing by turning on the accelerometer and sampling its output at a looking for the highest amount of acceleration that is sampled, and holding that level for a few seconds.

130. A method for transmitting information on the physical status of a subject, wherein

a bandwidth limited chest expansion voltage of a respiration monitor is sampled,

an algorithm determines when the wearer is inhaling or exhaling by looking at the relative change in the sampled signal, effectively taking a first order derivative that removes the DC component of the signal,

timing an analyzing a binary signal (inhaling or exhaling) for consistent behavior,

if several similar (+/- 25%) timed breaths are seen, they are averaged together and used as the final respiration value,

if no consistent breaths are seen in a 30 second period, the respiration rate is set to "unstable",

if no chest expansion/contraction is seen for over a minute, respiration rate is set to zero.

131. A system for processing information on the physical status of one or more subjects comprising

a sensor subsystem designed to:

capture and convert the analog data into digital form,

perform error detection processing,

validate the proper application and operation of hardware systems, perform combined analysis of the biometric data, yielding the overall health metric,

assemble and transmit periodic data packets to the hub subsystem, and

accept data received from the hub subsystem, applying configuration or command sets to update operational parameters, and

a hub subsystem designed to:

collect periodic data from the sensor subsystem(s),

buffer samples for transmission to the remote station;

provide minimal user interface capabilities to display the overall health status, and allow for sensor subsystem selection to be performed;

perform additional health status processing if multiple sensors are available to a single hub;

provide the uplink processing and data packaging for remote/PDA accesses, and

a remote subsystem designed to:

provide status display of multiple hubs;

provide expanded status display of one selected hub; and

provide long-term data logging for all hubs connected.

132. A system for processing information on the physical status of one or more subjects comprising

a first protocol for transferring data from a vital signs sensor to a hub, which comprises a concentrator and gateway to a remote station and

a second protocol for transferring data between the hub, and a remote viewing station that may be either a medic PDA, or a grouped display.

133. The system for processing information on the physical status of one or more subjects of claim 132, wherein the first protocol provides communications locally between one or more body-worn sensors, and a physically proximate hub/gateway.

134. The system for processing information on the physical status of one or more subjects of claim 133, wherein the data transmitted from the sensor to the hub comprises sensor data and control data.

135. The system for processing information on the physical status of one or more subjects of claim 134, wherein the sensor data contains the data values obtained from one or more vital signs sensors that are present and the control data is sent in response to a command from the hub.

136. An apparatus for transmitting information on the physical status of a subject comprising

a 32 Hz clock as the basic timer, and

a processor running an algorithm that looks at 4 seconds or more of EKG data to determine trends and includes filtering trend tracking and analysis, executed at an 8 Hz rate,

wherein averaging/filtering is run once every two seconds, and the resulting EKG rate is converted to a beats-per-second value every two seconds.

Algorithm specifics

137. A method for transmitting information on the physical status of a subject comprising

interrupting a processor when EKG electrical impulses of sufficient magnitude arrive,

time stamping every interrupt and saving a record of its having happened

stop recording interrupts if too many EKG pulses are still waiting processing by the filtering process

periodically clearing the list of pending interrupts

removing presumably incorrect EKG information by applying low pass filtering and noise cancellation.

138. The method for transmitting information on the physical status of a subject of claim 137, wherein the low pass filter discards incoming pulses that occur less than 125 msec after the previous good pulse.

139. A system for processing information on the physical status of one or more subjects comprising

a sensor in carrier for sensors that communicates wirelessly with a health hub comprising a device having a processor.

140. The system for processing information on the physical status of one or more subjects of claim 139, further comprising a RF transceiver operating at the same frequency at both ends of the wireless link sending Manchester encoded data.

141. The system for processing information on the physical status of one or more subjects of claim 139, wherein the information is sent in packets with error correction bits.

142. A system for processing information on the physical status of one or more subjects comprising a health status algorithm that

receives copies of the newly received data,

places the data into individual parameter data buffers

executes once per second, the health status algorithm on the data buffers,

updates the display of the health status, along with the confidence score of that determination.

143. The system for processing information on the physical status of one or more subjects of claim 142, wherein the health status algorithm comprises the steps of:

data gathering and buffering;

data averaging and conversion from numeric/symbolic into qualified range data;

rule lookup processing;

confidence scoring; and

result display.

144. The system for processing information on the physical status of one or more subjects of claim 142, wherein the step of data gathering and buffering comprises

incrementing once per second the current sample index of these buffers, and

new sample index flags are cleared.

145. The system for processing information on the physical status of one or more subjects of claim 143, wherein the conversion from source data to qualified data comprises

processing each parameter ring buffer to provide the average value of the data within the ring buffer,

comparing the average value to defined range boundaries, and

returning a qualified data range value.

146. The system for processing information on the physical status of one or more subjects of claim 143, wherein rule lookup processing comprises

having a bitmap of qualified data range results for each parameter, along with a result state to be used when a match is found,

once the current states of the ring buffers has been obtained, these states are compared to each rule until either a match is detected, in which case the corresponding health state is used, or all rules have been checked, in which case a default state is used.

147. The system for processing information on the physical status of one or more subjects of claim 143, wherein confidence scoring comprises

determining whether or not the current health state has changed,

determining the health state and confidence score,

displaying new values on the main dialog, in Hub Health State and Hub Confidence fields.

148. The system for processing information on the physical status of one or more subjects of claim 130, further comprising a medic PDA subsystem designed to establish a communications link to a single hub unit; and provide display of all available sensor data and status information.

Table 1. LSDS Platform Parameters and Error Conditions

Sensor	Primary Life Sign Parameter	Additional Data	Error Conditions from Sensor
R-Wave Detector	HR	Presence of signal (Yes or No) Heart rate variability	Leads Off Noisy Lead Signal not detected Out of range – high Out of range – low Sensor INOP
Temperature Sensor	Temp (an estimate of core body temperature value based on External Body Temperature as affected by ambient temperature)	External body temperature	Signal not detected Out of range – high Out of range – low Sensor INOP
Accelerometer	Speed of motion (None, Slow, Medium, High, or Off-scale Shock)	Body Position (Vertical/Upright, Vertical/Upside-down, Horizontal)	Sensor INOP
Respiration	Presence of Respiration (Yes or No)	Respiration Rate Tidal volume indicator Time since last breath Presence of motion	Bad signal (voltage too high or too low) No breath detected Out of range – high Out of range – low Sensor INOP
Other Information from Sensor Platform	Platform ID (device serial number, or possibly soldier ID number)	Time Stamp of data packet	Low Battery

Table 2. Default Health State Classification Descriptions

Overall Health State	Color Code
Alive	♡ Green
Alive, but significantly outside "normal"	♡ Yellow
Dead	♥ Red
Uncertain (Incomplete or conflicting information from sensors)	♡ Blue
SENSOR PLATFORM NOT OPERATING (Determined by receiving platform, e.g., no data received at for a given prolonged interval)	♥ Black

Table 3. Default Life Signs Interpretation Rules for Alive/Green and Dead/Red States

Available Parameters	Interpretation Rule	
	Alive/Green	Dead/Red
HR only	HR ≤ 160 BPM and HR ≥ 40 BPM for 8 seconds or more	HR = 0 for 4 minutes or more HR <30 BPM for 10 minutes or more
RR only	RR ≤30 breaths/minute and RR ≥ 8 breaths/minutes for 8 seconds or more	RR = 0 for 5minutes or more
Acceleration/Position only	Insufficient to determine this state	Insufficient to determine this state
Temp only	Insufficient to determine this state	Insufficient to determine this state
HR and RR	[HR ≤ 160 BPM and HR ≥ 40 BPM and (RR ≤30 breaths/minute and ≥ 8 breaths/minutes)] for 8 seconds or more	HR = 0 and RR = 0 for 4 minutes or more
HR and Acceleration/Position	(HR ≤ 160 BPM and HR ≥ 40 BPM) and any acceleration value and any position value for 8 seconds or more (HR > 160 /BPM and HR ≤ 220 BPM) and (Acceleration is Medium or Fast for any Position value) for 8 seconds or more	HR = 0 and Acceleration is NONE (for any position value) for 4 minutes or more
HR and Temp	(HR ≤ 160 BPM and HR ≥ 40 BPM) and (Temp = NORMAL) for 8 seconds or more	HR = 0 and Temp ≠ NORMAL for 4 minutes or more
RR and Acceleration /Position	RR ≤30 breaths/minute and RR ≥ 8 breaths/minutes and any acceleration value and any position value for 8 seconds or more [(RR >30 breaths per minute and RR ≤ 45 breaths per minute) and Acceleration is Fast, for any Position value)] for 8 seconds or more	RR = 0 and Acceleration = NONE (any Position value) for 5 minutes or more
RR and Temp	RR ≤30 breaths/minute and RR ≥ 8 breaths/minutes and Temp is NORMAL for 8 seconds or more	RR = 0 and Temp ≠ NORMAL for 5 minutes or more
Acceleration /Position and Temp	Insufficient to determine this state	Insufficient to determine this state
HR, RR, and Acceleration /Position	[(HR ≤ 160 BPM and HR ≥ 40 BPM) and (RR ≤30 breaths/minute and RR ≥ 8 breaths/minutes) and (any acceleration value and any position value)] for 8 seconds or more [(HR > 160 /BPM and HR ≤ 220 BPM) and (RR >30 breaths per minute and RR ≤ 45 breaths per minute) and Acceleration is Fast, for any Position value)] for 8 seconds or more	[(HR = 0) and (RR = 0) and (Acceleration is NONE for any Position value)] for 4 minutes or more
HR, RR, and Temp	[(HR ≤ 160 BPM and HR ≥ 40	[(HR = 0) and (RR = 0) and (any

	BPM) and (RR ≤30 breaths/minute and RR ≥ 8 breaths/minutes) and (Temp is NORMAL)] for 8 seconds or more	Temp ≠ NORMAL)] for 4 minutes or more
HR, Acceleration/Position and Temp	[(HR ≤ 160 BPM and HR ≥ 40 BPM) and (any acceleration value and any position value) and Temp is NORMAL]for 8 seconds or more [(HR > 160 /BPM and HR ≤ 220 BPM) and (RR >30 breaths per minute and RR ≤ 45 breaths per minute) and (Acceleration is Fast, for any Position value) and Temp is NORMAL] for 8 seconds or more	[(HR = 0) and (Acceleration is NONE for any position value) and Temp ≠ NORMAL)] for 4 minutes or more
RR, Acceleration /Position and Temp	[(RR ≤30 breaths/minute and RR ≥ 8 breaths/minutes) and (any acceleration value and any position value) and Temp is NORMAL] for 8 seconds or more [(RR >30 breaths per minute and RR ≤ 45 breaths per minute) and (Acceleration is Fast, for any Position value) and Temp is NORMAL] for 8 seconds or more	[(RR = 0) and (Acceleration = NONE for any Position value) and Temp ≠ NORMAL)] for 5 minutes or more
HR, RR, Acceleration /Position and Temp	[(HR ≤ 160 BPM and HR ≥ 40 BPM) and (RR ≤30 breaths/minute and RR ≥ 8 breaths/minutes) and (any acceleration value and any position value) and Temp is NORMAL] for 8 seconds or more [(HR > 160 /BPM and HR ≤ 220 BPM) and (RR >30 breaths per minute and RR ≤ 45 breaths per minute) and Acceleration is Fast, for any Position value) and Temp is NORMAL] for 8 seconds or more	[(HR = 0) and (RR = 0) and (Acceleration is NONE for any Position value) and Temp ≠ NORMAL] for 4 minutes or more

Table 4. Default Life Signs Interpretation Rules for Alive/Yellow State

Available Parameters	Interpretation Rules
HR only	[(HR < 40 BPM and HR ≠ 0 BPM) or (HR> 160 BPM)] for 8 seconds or more
RR only	[(RR<8 breaths/min and RR ≠ 0 breaths/min) or RR > 30 breaths/min)] for 8 seconds or more
Acceleration only	Insufficient to determine this state
Temp only	Insufficient to determine this state
HR and RR	[(HR < 40 BPM and HR ≠ 0 BPM) and/or (HR> 160 BPM) or (RR<8 breaths/min and RR ≠ 0 breaths/min) or RR > 30 breaths/min)] for 8 seconds or more
HR and Acceleration	[(HR < 40 BPM and HR ≠ 0 BPM and any acceleration value) or (HR> 160 BPM and Acceleration is NONE)] for 8 seconds or more
HR and Temp	[(HR < 40 BPM and HR ≠ 0 BPM for any Temp value) or (HR> 160 BPM and Acceleration < Medium for any Position value and any Temp value)] for 8 seconds or more
RR and Acceleration /Position	[(RR<8 breaths/min and RR ≠ 0 breaths/min and any acceleration value and any position value) or (RR > 30 breaths/min and Acceleration < Medium for any Position value)] for 8 seconds or more
RR and Temp	[(RR<8 breaths/min and RR ≠ 0 breaths/min and any Temp value) or (RR > 30 breaths/min and any Temp value)] for 8 seconds or more
Acceleration /Position and Temp	Insufficient to determine this state
HR, RR, and Acceleration /Position	[(HR < 40 BPM and HR ≠ 0 BPM) and/or (RR<8 breaths/min and RR ≠ 0 breaths/min) for any Acceleration value and any Position value] for 8 seconds or more [(HR> 160 BPM and/or RR > 30 breaths/min) and Acceleration < Medium for any position value] for 8 seconds or more
HR, RR, and Temp	[(HR < 40 BPM and HR ≠ 0 BPM) and/or (RR<8 breaths/min and RR ≠ 0 breaths/min) and any Temp value] for 8 seconds or more [(HR> 160 BPM and/or RR > 30 breaths/min) and any Temp value] for 8 seconds or more
HR, Acceleration/Position and Temp	[(HR < 40 BPM and HR ≠ 0 BPM and any acceleration value and any Temp value) or (HR> 160 BPM and Acceleration < Medium and any Temp value)] for 8 seconds or more
RR, Acceleration /Position and Temp	[(RR<8 breaths/min and RR ≠ 0 breaths/min and any acceleration value and any position value and any Temp value) or (RR > 30 breaths/min and Acceleration < Medium for any position value and any Temp value)] for 8 seconds or more
HR, RR, Acceleration /Position and Temp	[(HR < 40 BPM and HR ≠ 0 BPM) and/or (RR<8 breaths/min and RR ≠ 0 breaths/min) for any Acceleration value and any Position value and any Temp value] for 8 seconds or more [(HR> 160 BPM and/or RR > 30 breaths/min) and Acceleration < Medium for any Position value and any Temp value] for 8 seconds or more

Table 5. Default LSDS Alive/Normal Data Ranges

Sensor	Parameter	Data Description (Raw Data Range)	"Normal" Range
R-Wave Detector	Heart Rate	Numeric (0 BPM, and 15 – 250 BPM)	40 – 160 BPM
	Presence of Heartbeat	Boolean (T or F)	TRUE
Respiration Detector	Presence of Respiration	Boolean (T or F)	TRUE
	Respiration Rate	Numeric (0 – 60 breaths/min)	8 – 30 breaths/min
	Tidal Volume Indicator (High, Medium, Low)	Integer (2, 1, 0)	High, Medium or Low
	Time Elapsed Since Last Breath	Numeric (0 – 60 seconds)	Not applicable
	Presence of Motion	Boolean (T or F)	TRUE or FALSE
Accelerometer	Speed (None, Slow, Medium, Fast)	Integer (0, 1, 2, or 3)	0 - 3
	Position (Upright, Horizontal, or Upside-Down)	Signed Integer (1, 0, or –1)	0 - 1
Temperature sensor	Estimated Core Temperature	Numeric (0 - 50°C)	NORMAL (36.4°C – 38.9°C)
	External Temperature	Numeric (0 - 50°C)	Not applicable

Table 6. Default LSDS Alive/Not-Normal Data Ranges

Parameter	Abnormal High	Abnormal Low
HR	161 and higher	39 and lower
RR	31 and higher	7 and lower
Skin Temp	>39°C	<36°C
Acceleration	Not Applicable	Not Applicable
Position	Not Applicable	Not Applicable

Table 8. Default Decision Matrix for Only One Parameter in Last Decision Interval

Parameter	Value	New State	Value	New State	Value	New State	Value	New State
HR	Normal	Alive	Abnormal	Alive-Not-Normal	0 BPM	Dead	Present, can't calculate	Uncertain
RR	Normal	Alive	Abnormal	Alive-Not-Normal	0 breaths per min	Dead	Present, can't calculate	Uncertain
Acceleration	Any	Uncertain						
Position	Any	Uncertain						
Temp	Any	Uncertain						

Table 9. Default Decision Matrix for Two Parameters in Last Decision Interval

Parameters	Average Value Range 1	Average Value Range 2	Average Value Range 3*	New State
HR and RR	Normal	Normal		Alive
	Normal	Abnormal		Alive
	Normal	0		Alive/Not Normal
	Abnormal	Normal		Alive/Not Normal
	Abnormal	Abnormal		Alive/Not Normal
	Abnormal	0		Alive/Not Normal
	0	Normal		Alive/Not Normal
	0	Abnormal		Alive/Not Normal
	0	0		Dead
HR and Acceleration/Position	Normal	Any	Any	Alive
	Abnormal High	Fast	Any	Alive
	Abnormal High	Non-Fast	Any	Alive/ Not Normal
	Abnormal Low	None	Any	Alive/Not Normal
	Abnormal Low	Non-zero	Any	Alive/Not Normal
	0	Any	Any	Dead
HR and Temp	Normal	Normal		Alive
	Normal	H or L		Alive/Not Normal
	Abnormal	Normal		Alive/Not Normal
	Abnormal	H or L		Alive/Not Normal
	0	Any		Dead
RR and Acceleration/Position	Normal	Any	Any	Alive
	Abnormal High	Fast	Any	Alive
	Abnormal High	Non-Fast	Any	Alive/Not Normal
	Abnormal Low	None	Any	Alive/Not Normal
	Abnormal Low	Non-zero	Any	Uncertain
	0	Any	Any	Dead
RR and Temp	Normal	Normal		Alive
	Normal	Abnormal		Alive/Not Normal
	Abnormal	Normal		Alive/Not Normal
	Abnormal	Abnormal		Alive/Not Normal
	0	Normal		Dead
	0	Abnormal		Dead
Temp and Acceleration	Any	Any	Any	Uncertain

*Note that the third value range is only filled in for acceleration (acceleration and orientation).

Table 10. Default Decision Matrix for Three Parameters for Last Decision Interval

Parameters	Average Value Range 1	Average Value Range 2	Average Value Range 3	Average Value Range 4*	New State
HR, RR, and Acceleration	Normal	Normal	Any	Any	Alive
	Normal	Abnormal	Any	Any	Alive/Not Normal
	Normal	0	Any	Any	Alive/Not Normal
	Abnormal High	Normal	Any	Any	Alive/Not Normal
	Abnormal High	Abnormal High	Fast	Any	Alive
	Abnormal High	Abnormal High	Non-Fast	Any	Alive/Not Normal
	Abnormal High	Abnormal Low	Any	Any	Alive/Not Normal
	Abnormal High	0	Any	Any	Alive/Not Normal
	Abnormal Low	Normal	Any	Any	Alive/Not Normal
	Abnormal Low	Abnormal	Any	Any	Alive/Not Normal
	Abnormal Low	0	Any	Any	Alive/Not Normal
	0	Normal	Any	Any	Alive/Not Normal
	0	Abnormal	Any	Any	Alive/Not Normal
	0	0	Any	Any	Dead
HR, RR, and Temp	Normal	Normal	Any		Alive
	Normal	Abnormal	Any		Alive/Not Normal
	Normal	0	Any		Alive/Not Normal
	Abnormal	Normal	Any		Alive/Not Normal
	Abnormal	Abnormal	Any		Alive/Not Normal
	Abnormal	0	Any		Alive/Not Normal
	0	Normal	Any		Alive/Not Normal
	0	Abnormal	Any		Alive/Not Normal
	0	0	Any		Dead
HR, Temp, and Acceleration	Normal	Normal	Any	Any	Alive
	Normal	H or L	Any	Any	Alive/Not Normal
	Abnormal High	Normal	Fast	Any	Alive
	Abnormal High	Normal	Non-Fast	Any	Alive/Not Normal
	Abnormal High	Abnormal	Any	Any	Alive/Not Normal
	Abnormal Low	Any	Any	Any	Alive/Not Normal
	0	Any	Any	Any	Dead
RR, Temp and Acceleration	Normal	Normal	Any	Any	Alive
	Normal	Abnormal	Any	Any	Alive/Not Normal
	Abnormal High	Normal	Fast	Any	Alive
	Abnormal High	Normal	Non-Fast	Any	Alive/Not Normal
	Abnormal High	Abnormal	Any	Any	Alive/Not Normal
	Abnormal Low	Any	Any	Any	Alive/Not Normal
	0	Any	Any	Any	Dead

*Note that the fourth value range is only filled in for acceleration (acceleration and orientation).

Table 11. Default Decision Matrix for Four Parameters in Last Decision Interval

Parameters	Average Value Range 1	Average Value Range 2	Average Value Range 3	Average Value Range 4	Average Value Range 5	New State
HR, RR, Temp and Acceleration	Normal	Normal	Normal	Any	Any	Alive
	Normal	Normal	Abnormal	Any	Any	Alive
	Normal	Abnormal	Any	Any	Any	Alive/Not Normal
	Normal	0	Any	Any	Any	Alive/Not Normal
	Abnormal	Normal	*Any	Any	Any	Alive/Not Normal
	Abnormal High	Abnormal High	Any	Fast	Any	Alive
	Abnormal High	Abnormal High	Any	Non-Fast	Any	Alive/Not Normal
	Abnormal High	Normal	Any	Any	Any	Alive/Not Normal
	Abnormal High	Abnormal Low	Any	Any	Any	Alive/Not Normal
	Abnormal High	0	Any	Any	Any	Alive/Not Normal
	Abnormal Low	Normal	Any	Any	Any	Alive/Not Normal
	Abnormal Low	Abnormal	Any	Any	Any	Alive/Not Normal
	Abnormal Low	0	Any	Any	Any	Alive/Not Normal
	0	Normal	Any	Any	Any	Alive/Not Normal
	0	Abnormal	Any	Any	Any	Alive/Not Normal
	0	0	Any	Any	Any	Dead

*Note that the fifth value range is only filled in for acceleration (acceleration and orientation).

Table 12: State Change Score Components

# of State Change Steps	Variations	Total Probability	State Change Score	Influence on Conf Score
0	G↔G, Y↔Y, R↔R	60%	3	H
1	RH↔YH, YH↔G, G↔YL, YL↔RL	30%	2	M
2 or More	G↔RH, G↔RL	10%	1	L

Table 13. Persistence Score Components

Total # Times In New State	Score Range (Total -1)	Influence on Conf Score
7 - 8	6 - 7	H
5 - 6	4 - 5	M
4	3	L

Table 14. Components of Weight (Multiplier) by Parameter Set

Parameter Included in New State	Weight (Multiplier)	Influence on Conf Score
All	1.0	H
HR, RR, and Motion		
HR, RR, Temp	0.9	M
HR and RR		
HR and Temp	0.8	L
HR and Motion		
HR		
RR and Temp		
RR and Motion		
RR		

Table 15. Confidence Score Ranges

Confidence Level	Score Range
High	80<Score≤100
Medium	50< Score≤80
Low	Score <50

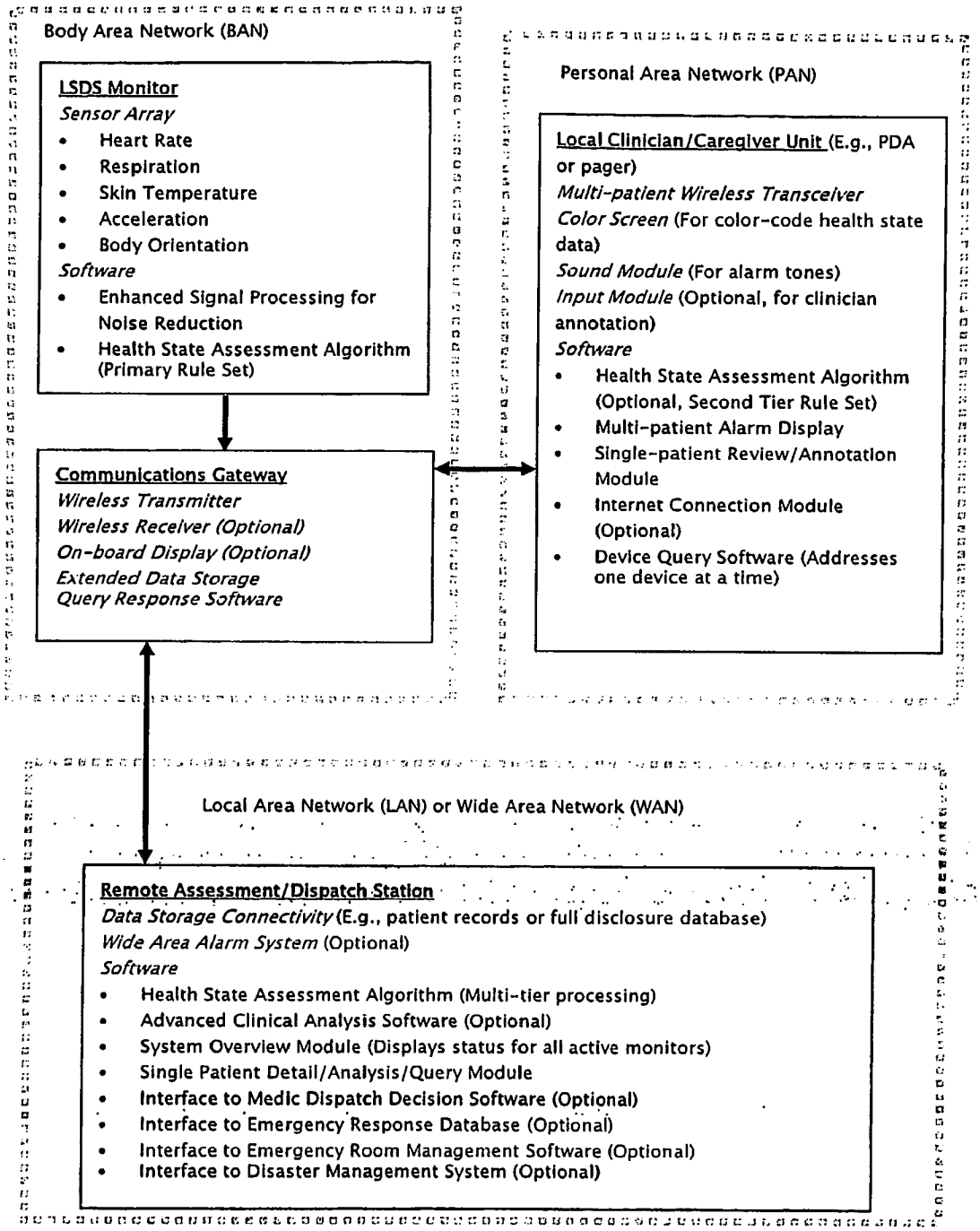

Figure 48 - Block Diagram :Life Signs Detection System